Prediction of Same-Day Discharge following Revision Total Knee Arthroplasty

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INTRODUCTION:

As the Centers for Medicare and Medicaid Services (CMS) recently removed revision total knee arthroplasty (rTKA) from the Inpatient Only list, we aimed to identify important preoperative and intraoperative characteristics that predict same-day discharge in these patients using machine learning algorithms**.** Accurately identifying patients likely to undergo same-day discharge, will allow for more optimized outpatient selection for rTKA, thus leading to better patient outcomes and reduced hospital expenditures. We hypothesize that our analyses will identify variables associated with increased overall health to be predictive of same-day discharge (SDD).

METHODS:

Data was obtained from the American College of Surgeons National Quality Improvement Program (ACS-NSQIP) database from the years 2018-2020. Patients with elective, unilateral rTKA procedures and a total hospital length of stay between 0-4 days were included. Demographic, preoperative, and intraoperative variables were analyzed. A multivariable logistic regression (MLR) model was compared to two machine learning techniques, Random Forest (RF) and Artificial Neural Network (ANN), using area under curve (AUC). Important and significant variables were identified from the models.

RESULTS:

In total, 5,600 patients were included in the final analyses, of which, 342 (6.1%) had same-day discharge. After multivariable logistic regression analysis, the following variables had a significant association with SDD: age (OR: 1.02 [1.01, 1.03], p=0.0024), body mass index (BMI) (OR: 1.03 [1.01, 1.05], p=0.009), sex (OR: 1.42 [1.10, 1.82], p=0.0062), diabetes (OR: 0.67 [0.48, 0.95], p=0.0253), dependent functional status (OR: 0.11 [0.02, 0.88], p=0.0366), moderate/severe anemia status (OR: 0.17 [0.05, 0.53], p=0.0025), severe American Society of Anesthesiology (ASA) grade (OR: 0.69 [0.54, 0.88], p=0.0034), operating time (OR: 1.02 [1.02, 1.02], p<0.0001), and neuraxial anesthesia (OR: 2.54 [1.96, 3.29], p<0.0001). The MLR, RF, and ANN models had AUCs of 0.808, 0.831, and 0.824 with the training dataset, respectively. The RF model identified shorter operating time as the most important variable for determining same-day discharge, followed by use of neuraxial anesthesia, younger age, lower BMI, ASA grade, race, history of diabetes, hypertension, male sex, and smoking status (Figure 1).

DISCUSSION AND CONCLUSION: To the best of our knowledge, this is the first study applying machine learning techniques such as RF and ANN to predict same-day discharge following rTKA. Among all three tested models, the RF model and ANN model performed better than the conventional MLR model, with the RF model yielding the highest AUC, demonstrating excellent accuracy and predictability. The results from our RF suggests that shorter operating time, neuraxial anesthesia type, age, lower BMI, ASA grade 1 and 2, white race, no history of diabetes, no hypertension, male sex, and negative smoking status are most predictive of same-day discharge following rTKA. With the rising emphasis on value-based care, orthopaedic surgeons may incorporate models such as these to accurately risk-stratify their patients preoperatively and determine candidates suitable for outpatient rTKA.

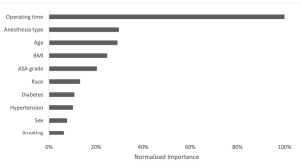

Figure 1. Normalized importance of pre- and intraoperative factors for same-day discharge based on Random Forest model. Importance is the degree to which the model is dependent on the factor.

ASA, American Society of Anesthesiologists; BMI, body mass index